DOCUMENT RESUME

ED 449 000 SE 064 016

AUTHOR Rebelatto, Daisy Aparecida do Nascimento; Sadalla, Lais O. B.; Belhot, Renato V.

TITLE A Service View of Engineering Education.

PUB DATE 1998-00-00

NOTE 6p.; Paper presented at the Annual Meeting of the International Conference on Engineering Education (Rio de Janeiro, Brazil, August 17-20, 1998).

PUB TYPE Opinion Papers (120) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS Educational Change; *Educational Development; *Educational Improvement; Engineering Education; Foreign Countries; Higher Education; *Relevance (Education); *Services; *Student Needs

IDENTIFIERS Brazil

ABSTRACT

This paper discusses and analyzes how engineering education, understood as a production system of learning and knowledge, can benefit from examining its practices through the metaphor of the service industry. The agents in the production process of teaching and learning are the customer, the product, the agent in transformation, and the quality control. (WRM)

Reproductions supplied by EDRS are the best that can be made
from the original document.

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

D. Rebelatto

A SERVICE VIEW OF ENGINEERING EDUCATION

Daisy A. N. Rebelatto, Lais O. B. Sadalla, Renato V. Belhot
Área de Engenharia de Produção
Escola de Engenharia de São Carlos - EESC - USP
Av. Dr. Carlos Botelho, 1465
13560-250 São Carlos - SP - Brasil

ED 449 000

Abstract *- The origin of the service as an economic activity happened at the pre industrial era and had the characteristics of personnal service. The emerge of the industries fortified the concept of employee job and modified the nature of the service activities. As the time went by, the differences between services and products were accentuated and the specific characteristics of service rendered were identified. The first specific characteristics identified to this sector were intangibility, heterogenity and inseparability. Some other characteristics were suggested as new researches were realized in the sector, based on its growth in the economic cenary. The service activity aims attend the customer expectations and its necessities not only in quantity but also in quality terms, and so on. Presumes the identification of three basic components: 1) the physical item, 2) the sensorial aspects (explicit), and 3) the psychological aspects (implicit). The sum of those three basic elements rises to the service package, that is, the physical item (what is offered to the customer) and the contact climate (enviromment and nature). Under the actual globalization conditions and changes on the educational paradigms it is being notorious the necessity of changing teaching techniques and emphazing the learning process. These would only occur if we make a better identification of the necessities and expectation of the customer involved in the process, which would be the student, the enterprises and the society. Besides, we would also have a better definition about the different ways to evaluate learning (not the teaching quality) and about the eficacy of the use of the resources (qualitatitve measures). What seems to be an interesting proposal is the apropriation of knowledge from one area to another what would allow the analysis of teaching activities through the concepts developed to the service activities. In this sense, the purpose of this paper is to discuss and analyse how the engineering education, understood as a production system of learning and knowledge, can take the benefits of the service sector to rise alternative possibilities through polemic questions as evaluation and quality of the education.*

The service had its origin as an economic activity in the pré-industrial era, characterized by the individual's personal dedication to others, creating a servitude relationship between the one who performs and the one who receives. It was not used to attribute a lot of prestige to that activity with exception to those related to the attendance of the body (doctors) or of the spirit (priests and artists) that deserved larger prominence and noble treatment.

With the appearance of the industries and the consequent invigoration of the concept of salaried work, the activities of services had its nature affected and the previous established servitude relationship was also altered. Then appeared the autonomous servers and the small companies which also performed service activities. As time went by, the differences between product and services started to get accentuated, with the identification of specific characteristics for each one of the activities.

Now the branch of services has been valued, mainly due to its association with the manufacture. In the manufacturing, each person that executes an activity possesses customer that belongs to the organization and external suppliers, forming a complex mesh of services. These services, that were not identified before, indicated the knowledge development of the administration of services as it can contribute to the industrial development. Besides, it happened to associate services and products in the after-sales phase, as repair, maintenance and training. Many enterprises obtain expressive profits with the services after-sale.

Defining service, despite of being quite intuitive idea , it is not a simple task. According to ELLENRIEDER [3], an appropriate definition could be: *"...an operation or group of operations, that are performed with the objective of is to increase the value of the state of some person or object."* Considering that the manufacture activity involves physical or chemical transformation, or the assembly of material input, and that this process odds value to these inputs, manufacturing could be defined as: *"...one operation or group of operations, performed with the objective of to increase the value of the state of some physical input"*. It may be observed that the two concepts present a proximity relationship and likeness that tends to confuse the two sectors in such a way that some areas are treated as manufacture, and in fact it would be more appropriate to treat them as services.

According to the international norm ISO 9004-2, service is generated by the interaction of activities between the server and the customer, where the customers' activities can be essential to the supply of the service and the delivery or use of some product can be part of the offer. This definition, however, comes in a very generic way, mainly in the concern of the statement that some tangible good can be offered or used as integral part of the offer. In that way, it can be

BEST COPY AVAILABLE

extended to a certain point, where the manufacture activities, either goods and services almost get overlaied and receive similar treatment.

Due to that similarity, experts have been involved into the discussion of the distinctions between services and manufacture, with the objective of visualizing its borders. Some differences between the manufacturing and service industries are presented in Table 1 [5].

Other authors have identified those characteristics in the tertiary sector, that differentiates the activities and values of the manufacture (secondary sector). As an example, LEVITT [4], defines four characteristics of services that are considered the most important ones: a) intangibility -differently from the physical products, the services are intangible. The nucleus of the offer of a service is an activity, a process, making difficult the evaluation of its quality because it counts with different subjective aspects; b) inseparability - the services are produced and consumed at the same time; therefore the production of the services doesn't happen as in the manufacture where the goods are produced, stocked, sold and later on, consumed; c) heterogenity - the services are highly variable and very dependent of whom executes it, of when and where it is executed, and also depend on who is receiving it; d) perecibility - the services cannot be stocked, since the production and consumption are simultaneous [2].

Table 1. Some Typical Differences Between Manufacturing Industries and Services.

Services	Physical Products
The service is immaterial	The good, is generally concrete
The property is usually not transfered	The property is transfered when someone buys it.
The service can not be resold	The good can be resold
The service can not be demonstrated before purchased	The good can be demonstrated before the purchase.
The production and the consuption are usually coincident	The consumption occurs after production.
Production, consumption and sale are united in the same physical space	Production, consumption and sale happen in different places
The service can not be transported	The good can be transported
The customer participates in the production	The salesman is not the producer
In most cases the direct contact is necessary	Direct contact is not possible between enterprise and customer.
The service can not be exported, but it is not true to the system of installment of service	The good can be exported.

A lot of researches have been accomplished to the sector of services, perhaps even though to the accelerated growth of the sector, that undoubtedly already assumes the condition of main economic tendency in most of the developed countries. As a result, several boardings are being thrown on the aspects that determine its quality.

It also seems logical that the sector of services should benefit from the application of the quality techniques used to the manufacture. If the reason to the search the improvement of the quality in manufactured products was to increase competition and competitiveness, those same reasons are applied to the sector of services. However, the characteristics defined as intangibility, heterogenity and inseparability of the service act as obstacles to the application of the techniques developed in the manufacture environment, because they do not allow the use of measures and patterns.

The literature presents several approaches concerning quality, exposed under the optics of services, as an example: a) transcendental approach - the perception of transcendental quality can exist similarly to the products, even though it is not objectively measurable; b) product-based approach - the product named "service" has its attributes represented in terms of supplier specification; c) manufacturing-based - quality takes the execution sense, where the supplier has the obligation to do what was previously established. d) user-centered approach - exactly as it happens with products, this approach can be measured starting from each consumer's subjective judgement; e) value-centered approach - there is not a difference from the manufacture boarding, depending on how much the consumer is willing or is able to pay for what is being offered.

Despite of all those concepts, the researchers and managers have been seeking for new ways with more practical orientation about the quality of services. It seems to be a consense that the quality that interests is the one that can be understood easily by the organization and adopted as a consistent goal. In this sense, the user-centered approach a long time recognized in the manufacture, it was rescued with a lot of emphasis in the service sector. This happens because, in services, the consumer's direct presence exists provoking several interactions that difficult the previsibility with the supplier [6].

If we take those considerations into account, the problem of the present analysis is: ***Is it possible to analyse the teaching in engineering under the light of the concepts developed for the service activities? Is it possible to appropriate the knowledge developed for that activity, in a way to become more effective?***

Under the current conditions of globalization and the effects of new paradigms the need of changing the teaching process has been highlight, as well as the urgency of the valorization of the learning process.

According to BELHOT [1], the current educational paradigm should affect teachers and students in the same intensity. Today there is a difference in phase between amount of available knowledge and resources that are used in the education. The instructional model essentially based on the transmission and reception of the information, is presenting survival difficulty, due to the speed of the changes and the appearance of new information.

Another subject is about the insertion of the graduated professional in the labor market. The productive sectors are also suffering from changes, that may also be characterized, as paradigm changes, for example, the migration of the mass production to lean production. Those alterations are felt in the flexibility of equipments and in the professional's profile that are hired to act in that context. Changes are required in the professionals' formation, so that they have conditions to adapt to the new demands of the market. However, the engineer's formation didn't suffer the required alterations yet, and we continue preparing professionals with abilities that are, at least, debatable.

In the parallel of manufacture, it can be said that engineering education was conceived and developed in the same molds of the mass production. In the past, the education of the members of the noble families was made by mentors, especially hired to take care of the person's formation. While time went by, and because of the need of the extension of the education to a larger portion of the population, the education process by mentors became unfeasible and the educational process migrated for the mass education [7]. The fundamental principle of mass education is the same used by the companies, that is, to prioritize resources productivity and to establish measures for that productivity: graduated students, escape, reproof, number of students per room, etc. In Figure 1 we gathered those elements , where we can notice that the education should migrate for a new model, that is still being discussed.

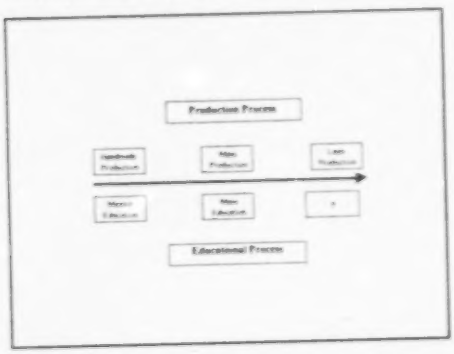

Figure 1 - Evolution of the production process and the teaching models used in the education

To the likeness of an assembly line, the student is going through the production process, that is, each semester and its respective disciplines. Each phase of the transformation process, has control points (evaluation) established in order to guarantee minimum patterns of quality, just as it happens in manufacture.

Once admitted, students go through a transformation process, composed by several disciplines that are necessary to its formation, as well as the raw material that is transformed in a production process. The school's evaluations correspond to the quality tests accomplished in the manufacture and, in the same way, as the product receives a label with the producer's name in the end of the process, the student receives a diploma, indicating that all the minimum requirements of quality were satisfied.

In this simplistic analogy with the manufacture, engineers (newly graduate) compete for a job, as well as the product compete for a place in the market. It is suggested, that the student is the final product, whose customer is the employer. Still according to this analogy, students that are inserted in the labor market correspond to the accomplished sales and the unemployed would correspond, in a first moment, to the stocks and, staying in this condition, to the remainings. We have then a suggestion of how to measure the actions performed by universities. Even though what happens in fact is that the university is evaluated by the number of students that receives the diploma, and not for how many of them indeed get employment in the market and guarantee their survival. It seems to be the same mistake that happens when quality of products are measured exclusively by quantitative aspects.

Finally, if the employer is considered the customers of the higher education, a newly graduate student's salary could be considered the minimum purchase price of the "product" in the market. The Table 2 synthesizes those information.

It seems necessary, however, that the engineering teaching develops and transposes the model adapted by of the secondary sector, mainly in respect of the development of strategies and organization. One of the main reasons for that conversion is due to the fact that the educational process deals with variables that presents difficulty on its quantification. Parameters as intelligence, emotions and behavior are integral parts of the teaching-learning process, and possesses as main characteristics the intangibility; the product of the teaching-learning process cannot be stocked. That same process will be developed in a different ways, depending on who executes it and who receives it - what characterizes the heterogenity.

Table 2 - Analogy Between Engineering Education and Manufacturing.

Engineering Education	Manufacturing
School elementary	Suplier
Freshman	Raw-material
Student	Product being processed
Course	Productive Process

BEST COPY AVAILABLE

Graduates	Final Product
Employer	Customer
Employed	Sales
Unemployed	Stock or balance
Initial salary	Price of the product

It seems necessary, however, that the engineering teaching develops and transposes the model adapted by of the secondary sector, mainly in respect of the development of strategies and organization. One of the main reasons for that conversion is due to the fact that the educational process deals with variables that presents difficulty on its quantification. Parameters as intelligence, emotions and behavior are integral parts of the teaching-learning process, and possesses as main characteristics the intangibility; the product of the teaching-learning process cannot be stocked. That same process will be developed in a different ways, depending on who executes it and who receives it - what characterizes the heterogenity.

When the idea of "service pachage" is analysed, we could stood out characteristics that favor the teaching process under the focus of services. The service activity is developed to assist the needs and the customer's expectations in quantitative and qualitative terms and, in that sense, it presupposes the identification of three basic components: 1) the physical item; 2) the sensorial aspects; and 3) the psychological aspects. These three basic components create the service package, that is, in another words, what is offered to the customer (physical item) and the climate of the contact (its enviromment and nature).

It may seems a relatively simple task to analyse the teaching-learning process as an activity of services. But in order to takes the benefits of the progresses obtained in the services sector, teaching activities should concentrate efforts in the identification of the agents of the process.

The first subject that appears, and of great complexity, is the definition of who would be the customer of the teaching-learning process. It is generally understood that students are the customer of the institution where they take part. Therefore, if the analysis should be done according to the customer's specific characteristics, it is verified that students do not meeet requirementes.

Firstly, a customer has the freedom of acquiring products or services available in the market. In other words, there is not any restriction related to the characteristics and abilities that prohibits customers to become a consumer, since they accept to pay the price that is being asked. The same doesn't happen in the higher education, because the universities are not open to everybody that want to be a regular student. Even if they are arranged to pay the costs, restrictive norms and admission tests exist for the interested ones.

A second aspect refers to the payment: the customers that acquire a product or service are obligatorily the one that is responsible for the payment of the costs from the purchase. An undergraduate student has the possibility to frequent a school whose expenses are assumed by the society or are on the responsibility of the student's family.

Another subject refers to the tests of merit and eligibility which the students of the university courses are submitted. In real conditions consumers are never tested to verify if they are making the correct use of what they have acquired and if they are taking sufficient advantage of the usage. Students, once they enter in the university are continually appraised to verify if they are assimilating what is being taught.

In order to begin discussions regarding this subject, this paper tries to identify the involved agents in the production process of teaching and learning:

a) **the customer** - the society seems to be the most evident proposal, here represented by the taxpayers (that finance the public schools), or by the families that are responsabilized for the student's expenses;

b) **the product** - the concepts developed for the service activities tell us that the product would be the change of behavior observed in students during and after their engineering education;

c) **the agent in transformation** - in a similarity with the health services, where the customer and the patient are not necessarily coincident, the student would be the receiver of the benefits of the process; and

d) **the quality control** - the labor market, with the option to accept the transformed agent or to reject it, seems to represent a form of quality control, that doesn't necessarily need to be done at the end of the process. The interaction is extremely beneficial, in this case, and it favors the quality control during the process of the student's formation.

Many other agents and phases of the process could be identified. Starting from the identifications already done, some teachers' disturbances may appear, as follows: if the quality control is done by the market, with the possibility to accept or to reject the transformed agent, then it is from the market that the specifications should come, regarding the professional that should be formed (profile). The starting point, for the planning of the teaching activities, becomes on what the community requires, based on a "knowledge of the real world" where the professional is expected to act. And not on the existent and well-known knowledge, from which it is chosen what should be taught and the way the content will be transmitted to the professional that is being prepared.

Like those, many other disturbances will appear as long as we discuss, analyse and identify the agents and the phases of the production process of teaching and learning, intending to adapt the knowledge generated in other areas. This would be equivalent to universities play their role, in the sense of qualifying the professional to act in new fields and to create new work opportunities. This is the discussion guided by the fields of professional performance.

If we specifically consider the subjects involving globalization and the technological evolution, it can be noticed that the dimensions placed in Table 1 [5], do not resist to a critical analysis, in function of the natural evolution of the

service sector. (linked to the transfer of property , to the resale of the services, to its demonstration before the purchase, to the production and consumption in a same space and to the impossibility of transporting the service).

In the same way, the exam of the subjects concerning teaching activities under the optics of the service theory, can no longer be done by the direct appropriation of concepts. It is already necessary to contemplate the evolution verified in the sector, so that engineering education can take the benefit of the progress obtained regarding the customer, the quality and the relationships among supliers , internal customers and external customers.

References

1) Belhot, R.V. "Reflexões e Propostas sobre o "Ensinar Engenharia para o Século XXI". *Tese* (Livre Docência), 1997, pp. 1-113, Escola de Engenharia de São Carlos, USP, São Carlos - SP.
2) Cavaness, J.P. & Manoochehri, G.H. "Building Quality into Services". *Sam Advanced Management Journal*, 1993, winter, pp. 4-8.
3) Ellenrieder, A.R.V. "Administração de Serviços: Parte 1: Conceitos". *Engenharia de Produção*, 1988, n. 1, pp. 3-6.
4) Levitt, T. "Administração de Serviços". In: Kotler, P. *Administração de Marketing*. Atlas, 1984, São Paulo - SP.
5) Normann, R. "*Administração de Serviços*". Atlas, 1993, São Paulo - SP.
6) Rebelatto, M.G. "A Qualidade em Serviços: Uma Revisão Analitica e Uma Proposta Gerencial". *Dissertação*, 1995, pp. 1-148, Escola de Engenharia de São Carlos, USP, São Carlos - SP.
7) Valente, J.A. "Ensinando Engenharia Através do Fazer Engenharia". *Relatório Técnico. NIED*, 1996, UNICAMP, Campinas - SP.